## HOW LIGHTNING HURTS US

A lightning strike in a crowded stadium is hazardous out to roughly 50 feet from the strike point, with one or two fatalities and dozens of injuries. People are occasionally injured 100 feet away from a strike. This is roughly equivalent to the kill radius and injury radius of a hand grenade. The mechanisms that hurt us are the millions of volts of electricity, the heat, and the thunderous blast from the rapidly expanding air.

**Ground current** occurs with each strike. You can minimize your exposure to ground current by keeping your feet close together, especially avoiding lying flat on the ground. Ground current contributes to half of lightning fatalities **(Fig. 1).** This is the primary mechanism where we can easily reduce lightning risks.

**Side flash** jumps from tall objects like trees when they are struck by lightning, so don't seek shelter near tall trees, other tall objects, or tall vertical surfaces.

**Contact** is from touching long conductors like railings, cables, and fences. Conduct a web search for *dead cow lightning* to see morbid images of contact and sideflash.

**Upward leaders** emanate from high ground and tall objects when downward leaders approach the ground: even if they don't connect with a downward leader, they can be fatal.

**Direct strikes** cause about 3-5 percent of lightning fatalities. Avoid high places and open ground to decrease risk of a direct strike.

The explosive force of lightning can cause **blunt trauma** resulting in fractures or soft tissue injuries.

**We should primarily focus our efforts on avoiding ground current and side flash.**

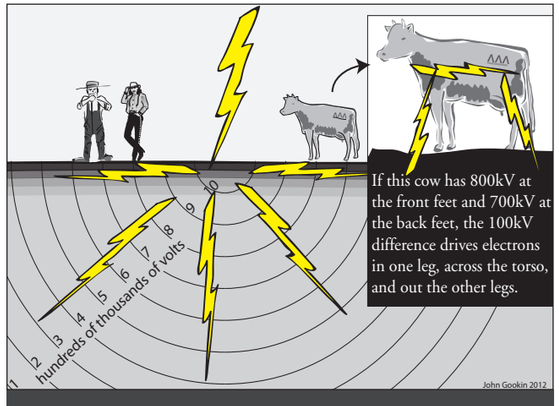



**Fig 1. Ground current** causes about half of all lightning injuries. A difference in voltage drives current through us. In this simplified illustration the cow has a 100,000-volt differential, one farmer has a 50,000-volt differential, and the other farmer has her feet together so her voltage difference is minimal.

## HOW LIGHTNING KILLS

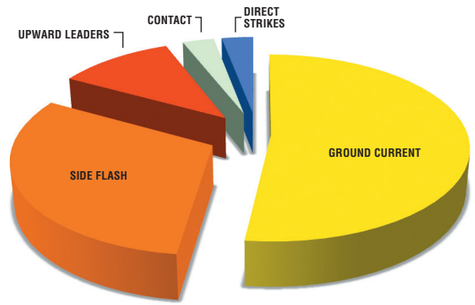



**Fig 2.** The frequencies of the primary lightning fatality mechanisms.

## FIRST AID FOR LIGHTNING VICTIMS

First Aid

The mechanisms that hurt us are electricity, heat, and the air blast. These cause many different kinds of neurological problems, burns, and trauma.

### TREATMENT PRINCIPLES

**Scene Safety:** Avoid further injuries. It may be safer to wait for the storm to pass before treating victims in extremely hazardous locations.

**Basic Life Support**: Be prepared to provide rescue breathing.

**Triage:** Unlike normal triage protocols, attend first to those who are in cardiac or respiratory arrest without obvious lethal injury.

**Assessment**: All patients require a complete body survey and careful evaluation for head, spinal, long bone, or cardiac injuries. Assess peripheral pulses, and sensory and motor status. Check the skin for small hidden burns.

**Monitor** for cardiovascular, respiratory, and neurological problems.

**Evacuate** anyone obviously injured by lightning. Be alert for lingering issues that need further evaluation and treatment. Survivors could be disoriented or confused. Their decision-making ability (including judgment, direction finding, and planning) could be dangerously impaired.

WHEN THUNDER ROARS
GO INDOORS!
www.lightningsafety.noaa.gov

## FRONTCOUNTRY LIGHTNING RISK MANAGEMENT

No place outside is safe from lightning. Frontcountry includes outdoor settings that are within a 30-minute walk of modern buildings or vehicles. This is where most lightning injuries occur because this is where people spend more time outdoors.

### TAKE THESE SIMPLE PRECAUTIONS TO STAY MUCH SAFER FROM THE LIGHTNING HAZARD:

- ☑ Get in a modern, enclosed building or a metal-topped vehicle if you hear thunder. Look up "Faraday cage" to see why this is so helpful and why the vehicle needs a metal roof to protect you.
- ☒ Avoid open shelters (like gazebos) and tall trees.
- ☑ Time your visits to high-risk areas with local weather patterns, so you aren't in a high-risk area at a high-risk time.

## WEBSITES ABOUT LIGHTNING

**National Weather Service Lightning Safety:** www.lightningsafety.noaa.gov
**NOLS Backcountry Lightning Risk Management:** www.nols.edu/lightning
**Medical Aspects of Lightning:** www.uic.edu/labs/lightninginjury
**Lightning Safety for Boaters:** www.wrh.noaa.gov/vef/boatersafety.php#lightning
**Youtube keywords for waiting for the storm to pass**: (use wireless devices) lightning strike tree, car, or plane; Faraday cage; lightning on the lawn

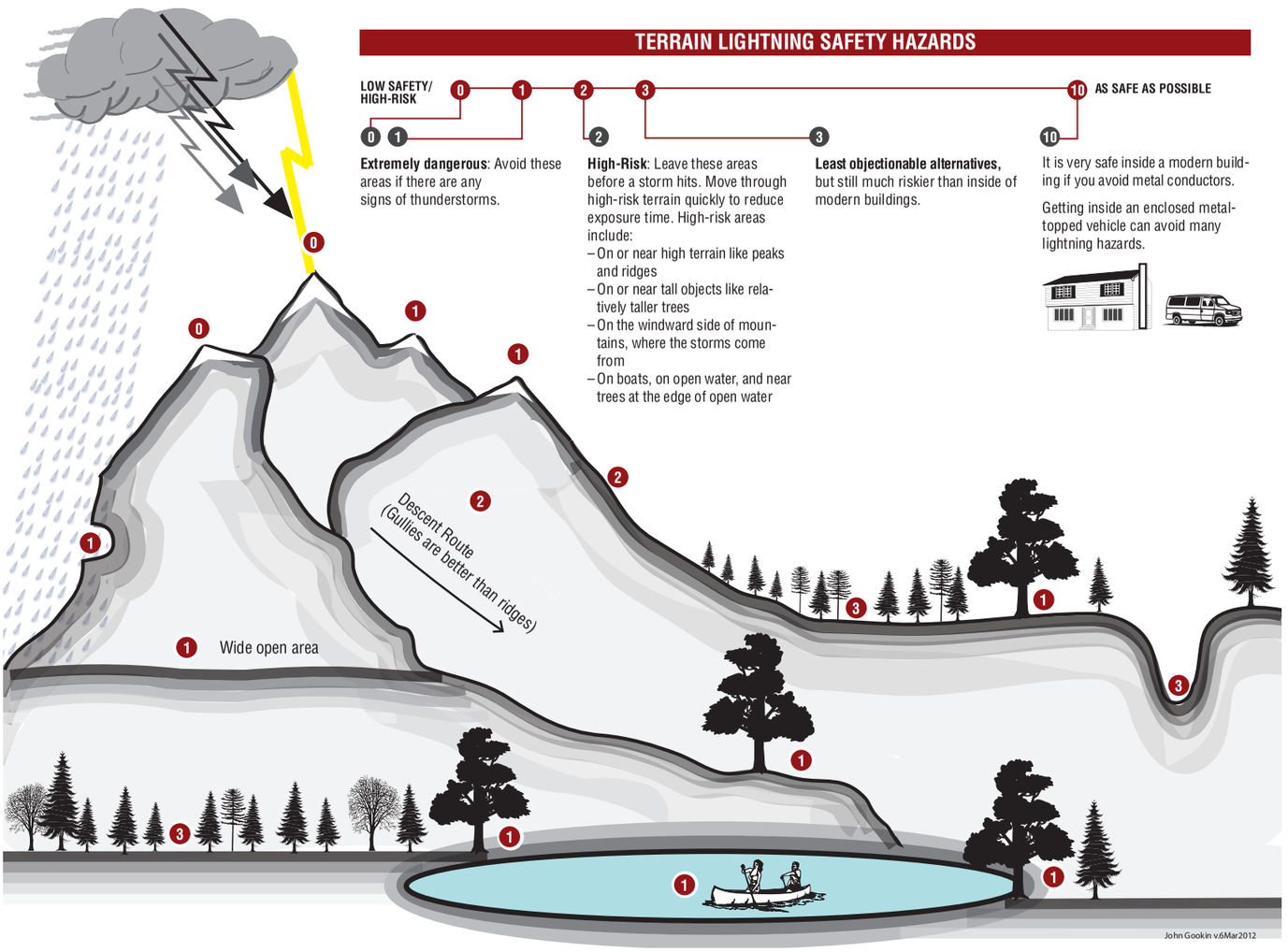
# LIGHTNING RISK MANAGEMENT

FOR BACKCOUNTRY CAMPERS AND HIKERS

NOAA
NATIONAL WEATHER SERVICE
NOLS

# BACKCOUNTRY LIGHTNING RISK MANAGEMENT

No place outdoors is safe from lightning. Lightning is an objective hazard. Your behavior can reduce the risk of that hazard harming you.




## REDUCING LIGHTNING RISK IN THE BACKCOUNTRY

**Backcountry settings** are at least a 30-minute walk from the nearest vehicles or modern buildings, where you can easily find safe shelter. There are four actions that can reduce your lightning risk in the backcountry, but none of them can make you as safe as getting in a modern building or a metal-topped vehicle. These behaviors are listed in order, and each is roughly twice as important as the next.

### 1. TIME YOUR VISITS TO HIGH-RISK AREAS WITH LOCAL WEATHER PATTERNS.

**Timing activities** with safe weather requires knowledge of both typical and recent local weather patterns. There is no such thing as a *surprise* or *freak* storm. You must set turnaround times that will get you off of exposed terrain before storms arrive. You need to observe the changing weather and discuss its status with your group. If you have logistical delays, you may need to change your plan rather than summiting a peak or crossing open ground during a thunderstorm. Begin your turnaround if you hear thunder (which means lightning is less than 10 miles away).

### 2. FIND SAFER TERRAIN IF YOU HEAR THUNDER.

**Safer terrain** in the backcountry can decrease your chances of being struck. Lightning tends to hit high points and the surrounding terrain. Avoid peaks, ridges, and significantly higher ground during an electrical storm. If you have a choice, descend a mountain on the side that has no clouds over it, since strikes tend to be less frequent on that side until the clouds move over it. Once you get down to low, rolling terrain, strikes are so random you shouldn't worry about terrain as much. Move to safer terrain as soon as you hear thunder, not when the storm is upon you.

**Select tent sites** that may reduce your chances of being struck or affected by ground current. If you are in a tent in "safer terrain" and you hear thunder, you at least need to be in the lightning position. Lying flat increases the risk of injury by ground current.

If your tent is in a more dangerous location, such as on a ridge, in a broad open area, or near a tall tree, you must exit the tent and get to safer terrain before the storm arrives, and stay there until it has passed.

**In gently rolling hills,** lower flat areas are not safer than the higher flat areas because none of the gentle terrain attracts leaders. Strikes are random in this terrain. Look for a dry ravine or other significant depression to reduce risk.

The flash-bang ranging system measures how far away a thunderstorm is, but sometimes it is impossible to tell which flash is associated with which bang. The flash of light travels fast enough that it is virtually instantaneous. The sound travels a mile every five seconds (1km/3 sec) so ideally you just count the number of seconds between the obvious flash and the obvious bang, and divide by five to determine how many miles away the storm is. Divide the time by three to see how many kilometers distant the storm is. Do not stake your life on the reliability of this ranging system.

### 3. AVOID TREES AND LONG CONDUCTORS ONCE LIGHTNING GETS CLOSE.

**Wide open ground** offers high exposure to lightning. Avoid trees and bushes that rise above others, since the highest objects tend to generate upward leaders. Your best bet is to look for an obvious ravine or depression before the storm hits, then spread out your group at 20 foot (7m) intervals to reduce the risk of multiple injuries. Assume the lightning position.

**Cavers (Fig. 3)** should avoid cave entrances during thunderstorms. Small overhangs can allow arcs to cross the gap. Natural caves that go far into the ground can be struck, either via the entrance or through the ground. People have been shocked standing in water half a mile inside caves. If you are caving near an entrance during electrical activity, don't stand in water, avoid metal conductors like ladders, cables, and railings, and avoid bridging the gap between ceiling and floor.

**Fig 3.** Overhangs, rock shelters, and cave entrances are especially hazardous because lightning travels along vertical surfaces to seek the ground. When lightning jumps a gap, any object bridging that gap can help conduct the current. Standing near the edge of an overhang is extremely dangerous during a thunderstorm. This even includes standing on the porch of a building where you could help conduct current across the open gap at the edge.

**Boaters** need to start getting off the water long before a storm arrives. Avoid tall trees near the edge of the water.

### 4. GET IN THE LIGHTNING POSITION IF LIGHTNING IS STRIKING NEARBY AND YOU CAN'T GET TO SAFER TERRAIN.

The lightning position **(Fig. 4)** is for waiting out storms in stationary situations when it is impractical to move to a safer location. It is important to reduce your overall footprint on the ground (**Fig.1**).

**Fig. 4 Lightning positions**: Put your feet together to significantly reduce the effects of ground current. If you have a foam pad to stand on or a pack to sit on, get on it. Crouch or sit to slightly reduce the effects of side flash and upward leaders.